SAR Evaluation Report

IN ACCORDANCE WITH THE REQUIREMENTS OF
FCC REPORT AND ORDER:
ET DOCKET 93-62, AND OET BULLETIN 65 SUPPLEMENT C

FOR

802.11a/b/g CARDBUS CARD

MODEL: AR5BCB-00062

FCC ID: PPD-AR5BCB-00062

REPORT NUMBER: 04U3043-7 (5GHz)

ISSUE DATE: December 20, 2004

Prepared for

Atheros Communications, Inc.
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Prepared by

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LAB CODE:200065-0

Revision History

Rev.	Revisions	Revised By

CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

DATES OF TEST: December 14 – 20, 2004

APPLICANT:	Atheros Communications, Inc.
ADDRESS:	529 Almanor Avenue Sunnyvale, CA 94085, USA
FCC ID:	PPD-AR5BCB-00062
MODEL:	AR5BCB-00062
DEVICE CATEGORY:	Portable Device
EXPOSURE CATEGORY:	General Population/Uncontrolled Explosure

802.11a/b/g CARDBUS CARD			
Test Sample is a:	Production unit		
Modulation type:	Direct Sequence Spread Spectrum (DSSS) for 802.11b Orthogonal Frequency Division Multiplexing (OFDM) for 802.11a/g		
FCC Rule Parts	Frequency Range [MHz]	The Highest SAR Values [1g_mW/g]	Max. Power Output [dBm]
15 SUBPART E	5180 - 5360	0.737	17.2 (average)
15 SUBPART C	5725 - 5785	0.582	17.1 (average)

Note: The 5.2 & 5.8 GHz bands are applicable to this report; other band of operation (2.4GHz) is documented in a separate report.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for General Population/Uncontrolled Explosure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC OET 65 Supplement C (Edition 01-01).

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Released For CCS By:

Hsin-Fu Shih

Hsin-Fu Shih (Sunny Shih)
COMPLIANCE CERTIFICATION SERVICES

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1 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

802.11a/b/g CARDBUS CARD Note: The 5.2 & 5.8 GHz bands are applicable to this report; other band of operation (2.4GHz) is documented in a separate report.	
Normal operation:	Lap-held position with the bottom of the computer in direct contact against a flat phantom
Duty cycle:	100% for 802.11abg
Host Device(s):	Host # 1: Toshiba, TECRA 8200 Host # 2: IBM, 2896 Host # 3: Dell, PP05L
Power supply:	Power supplied through the laptop computer (host device)

2 FACILITIES AND ACCREDITATION

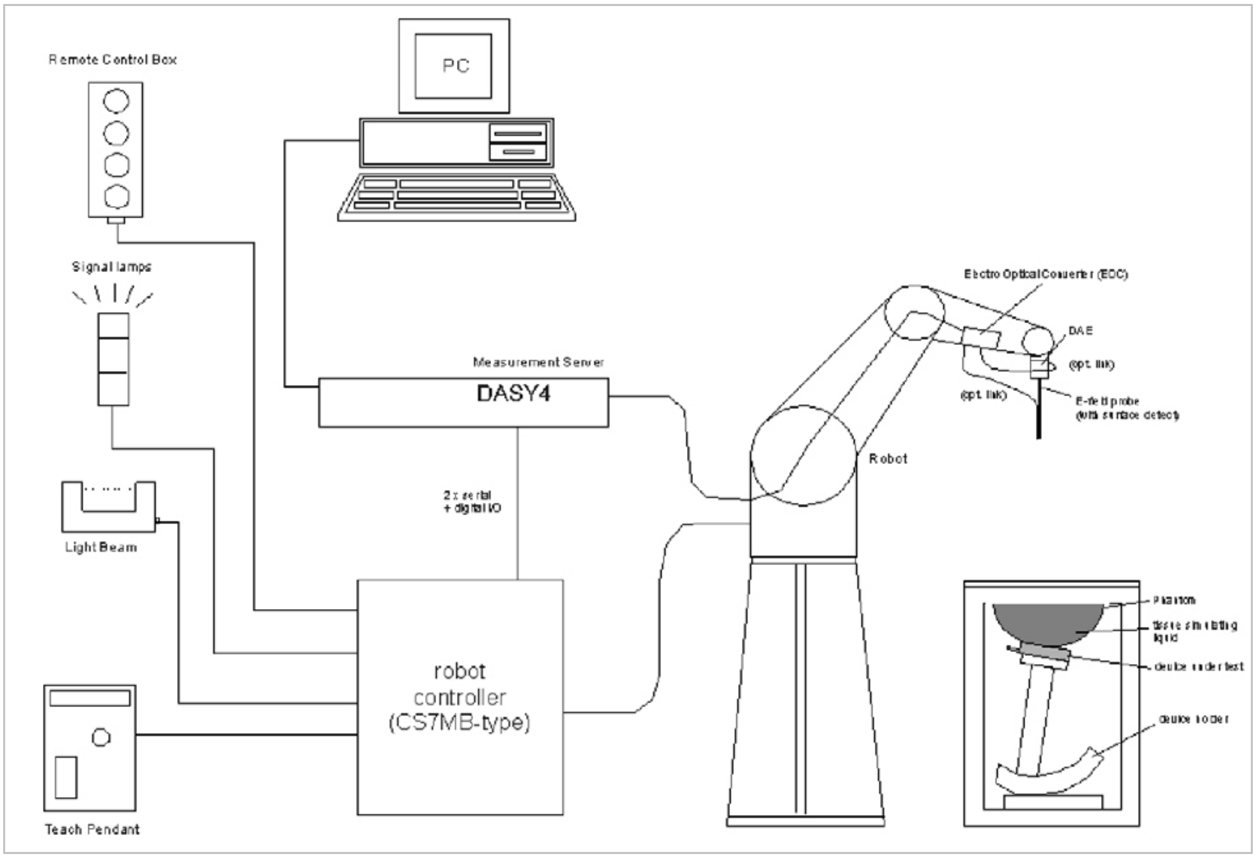
The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

LAB CODE:200065-0

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

3 SYSTEM DESCRIPTION



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

4 SYSTEM COMPONENTS

4.1 DASY4 MEASUREMENT SERVER

The DASY4 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

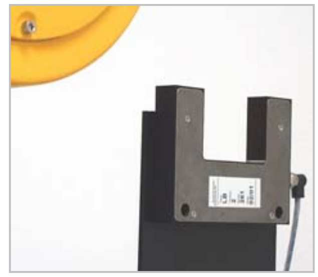
4.2 DATA ACQUISITION ELECTRONICS (DAE)

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

4.3 EX3DV3 ISOTROPIC E-FIELD PROBE FOR DOSIMETRIC MEASUREMENTS

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.3 dB in HSL (rotation around probe axis); ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range:	10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions:	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

4.4 LIGHT BEAM UNIT



The light beam switch allows automatic ”tooling” of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

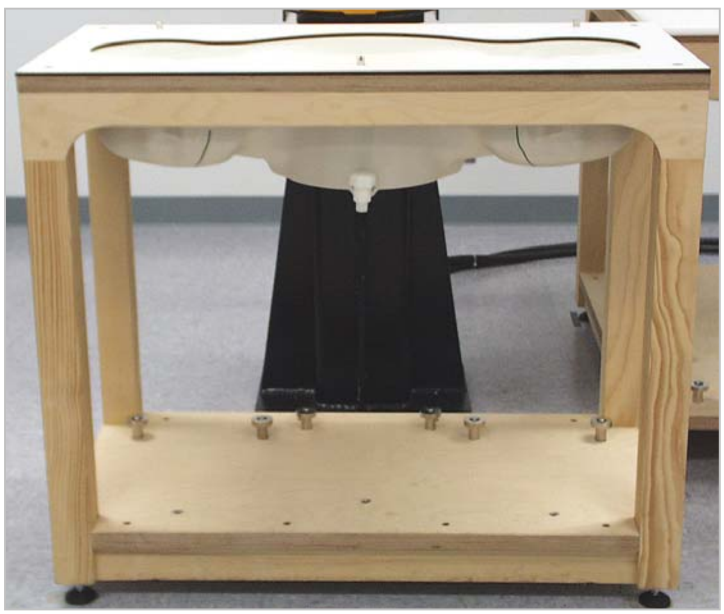
4.5 SAM PHANTOM (V4.0)

Construction: The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness: 2 ±0.2 mm

Filling Volume: Approx. 25 liters

Dimensions: Height: 810mm; Length: 1000mm; Width: 500mm



4.6 DEVICE HOLDER FOR SAM TWIN PHANTOM

Construction: In combination with the Twin SAM Phantom V4.0 or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

4.7 SYSTEM VALIDATION KITS

Construction: Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 450, 900, 1800, 2450, 5800 MHz

Return loss: > 20 dB at specified validation position

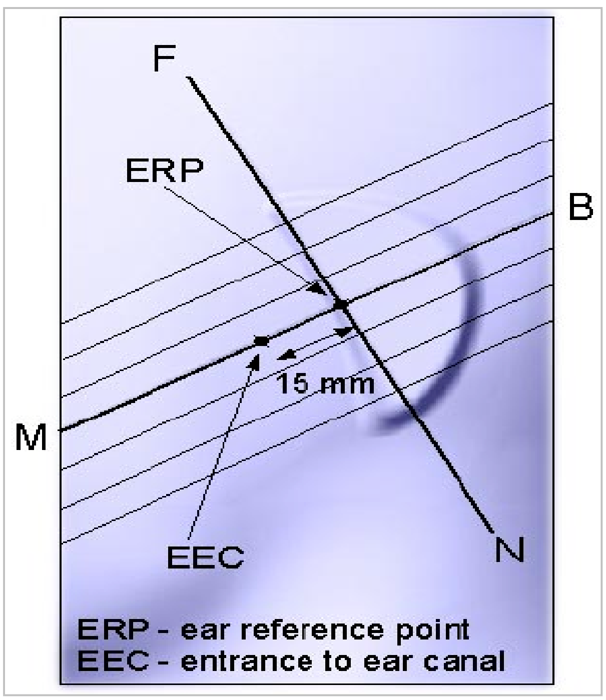
Power capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

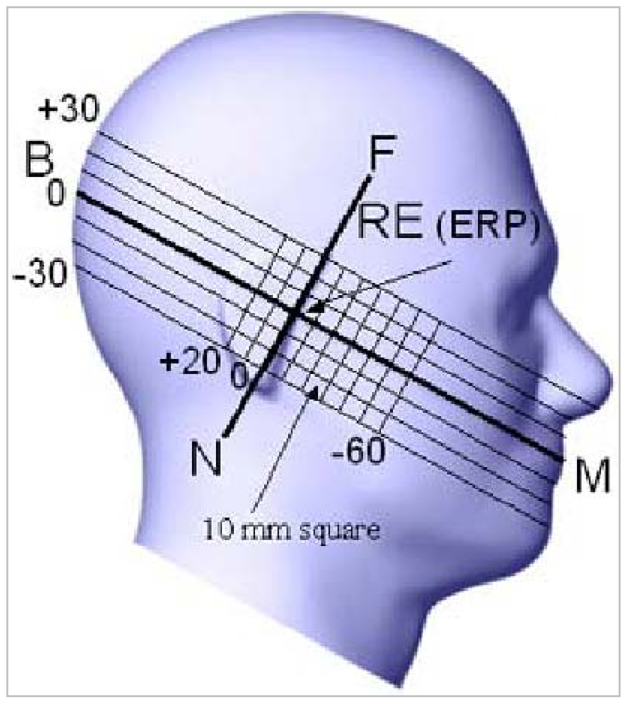
Dimensions: 450V2: dipole length: 270 mm; overall height: 330 mm
D900V2: dipole length: 149 mm; overall height: 330 mm
D1800V2: dipole length: 72 mm; overall height: 300 mm
D835V2: dipole length: 161; overall height: 330
D1900V2: dipole length: 68; overall height: 300
D2450V2: dipole length: 51.5 mm; overall height: 300 mm D5GHzV2: dipole length: 25.5 mm; overall height: 290 mm

5 TEST POSITIONS FOR DEVICES OPERATING NEXT TO A PERSON'S EAR

This category includes most wireless handsets with fixed, retractable or internal antennas located toward the top half of the device, with or without a foldout, sliding or similar keypad cover. The handset should have its earpiece located within the upper ¼ of the device, either along the centerline or off-centered, as perceived by its users. This type of handset should be positioned in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point". The "test device reference point" should be located at the same level as the center of the earpiece region. The "vertical centerline" should bisect the front surface of the handset at its top and bottom edges. A "ear reference point" is located on the outer surface of the head phantom on each ear spacer. It is located 1.5 cm above the center of the ear canal entrance in the "phantom reference plane" defined by the three lines joining the center of each "ear reference point" (left and right) and the tip of the mouth.

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom. For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the "N-F" line defined along the base of the ear spacer that contains the "ear reference point". For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling. The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane". This is called the "initial ear position". While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR:





5.1 CHEEK/TOUCH POSITION

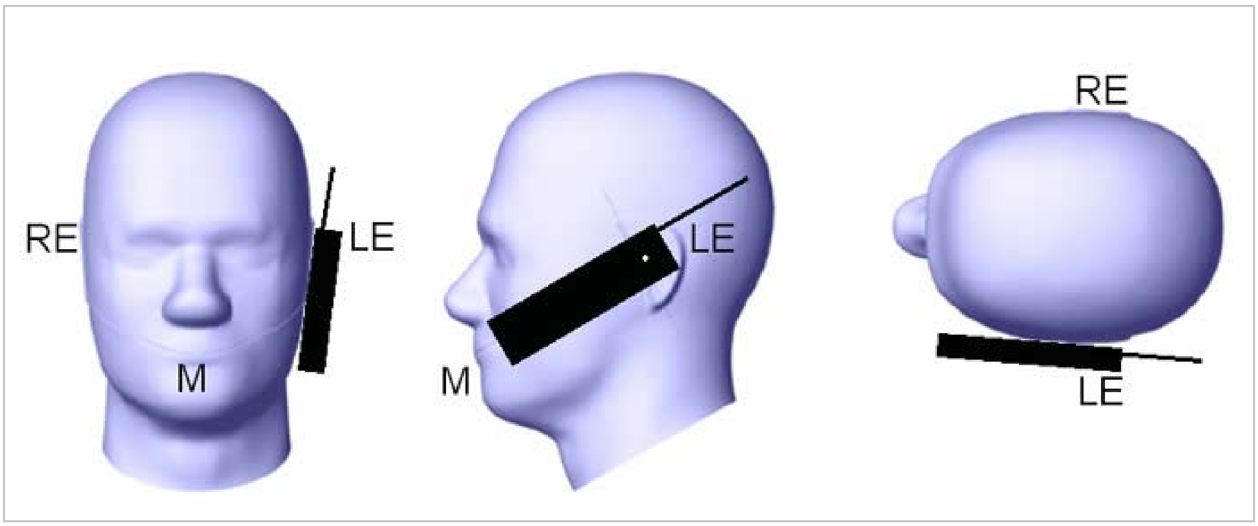
The device is brought toward the mouth of the head phantom by pivoting against the “ear reference point” or along the “N-F” line for the SCC-34/SC-2 head phantom.

This test position is established:

i. When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.
ii. (or) When any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

For existing head phantoms – when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touches the cheek of the phantom or breaks its last contact from the ear spacer.

Cheek / Touch Position



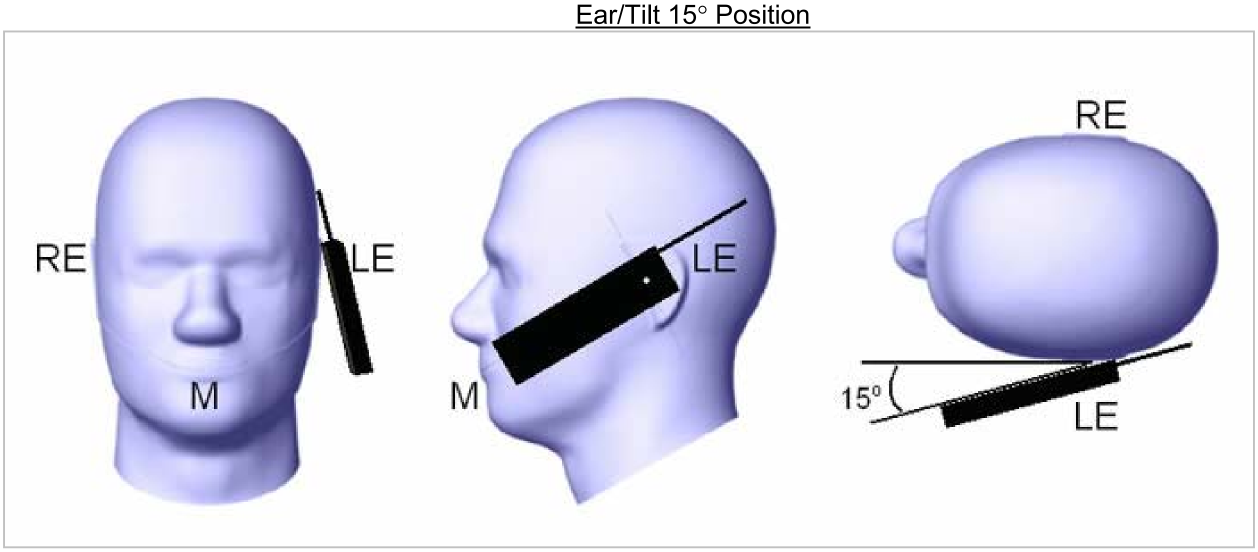
5.2 EAR/TILT POSITION

With the handset aligned in the “Cheek/Touch Position”:

i. If the earpiece of the handset is not in full contact with the phantom’s ear spacer (in the “Cheek/Touch position”) and the peak SAR location for the “Cheek/Touch” position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the “initial ear position” by rotating it away from the mouth until the earpiece is in full contact with the ear spacer.
ii. (otherwise) The handset should be moved (translated) away from the cheek perpendicular to the line passes through both “ear reference points” (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3 cm. While it is in this position, the device handset is tilted away from the mouth with respect to the “test device reference point” until the inside angle between the vertical centerline on the front surface of the phone and the horizontal line passing through the ear reference point isby 15°. After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both “ear reference points” until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

If a device is also designed to transmit with its keypad cover closed for operating in the head position, such positions should also be considered in the SAR evaluation. The device should be tested on the left and right side of the head phantom in the “Cheek/Touch” and “Ear/Tilt” positions. When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions. These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tile/Ear, extended and retracted) is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s). If the transmission band of the test device is less than 10 MHz, testing at the high and low frequency channels is optional.

Ear/Tilt 15° Position



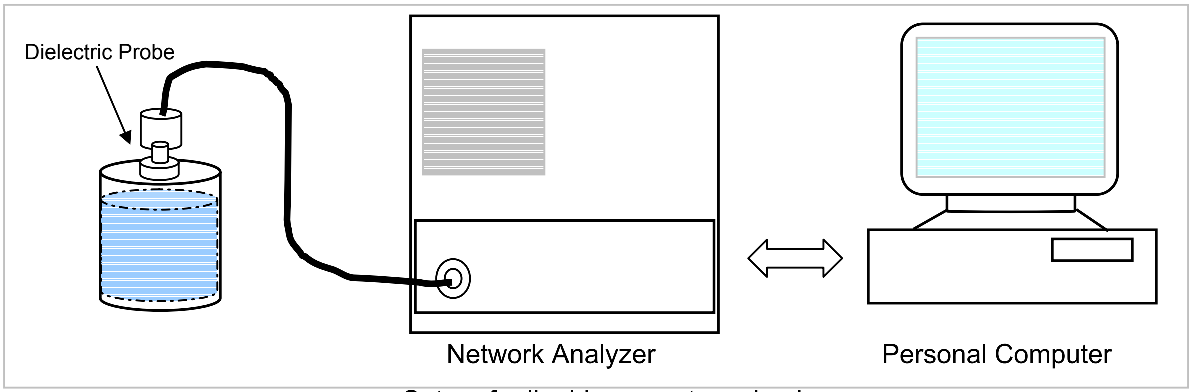
6 TEST POSITIONS FOR BODY-WORN AND OTHER SIMILAR CONFIGURATIONS

Lap-held

SAR is tested for a lap-held position with the bottom of the computer in direct contact against a flat phantom.

7 SIMULATING LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below.



Set-up for liquid parameters check

TISSUE SIMULATING LIQUIDS

In the current guidelines and draft standards for compliance testing of mobile phones (i.e., IEEE P1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given only at 3.0 GHz and 5.8 GHz. As an intermediate solution, dielectric parameters for the frequencies between 5 to 5.8 GHz were obtained using linear interpolation (see table below).

SPEAG has developed suitable head and body tissue simulating liquids consisting of the following ingredients: de-ionized water, salt and a special composition including mineral oil and an emulgators. Dielectric parameters of these liquids were measured suing a HP 8570C Dielectric Probe Kit in conjunction with HP 8753ES Network Analyzer (30 kHz – 6G Hz). The differences with respect to the interpolated values were well within desired ±5% for the whole 5 to 5.8 GHz range.

f (MHz)	Head Tissue		Body Tissue		Reference
	rel. permitivity	conductivity	rel. permitivity	conductivity	
3000	38.5	2.40	52.0	2.73	Standard
5800	35.3	5.27	48.2	6.00	Standard
5000	36.2	1.45	49.3	5.07	Interpolated
5100	36.1	4.55	49.1	5.18	Interpolated
5200	36.0	4.66	49.0	5.30	Interpolated
5300	35.9	4.76	48.9	5.42	Interpolated
5400	35.8	4.86	48.7	5.53	Interpolated
5500	35.6	4.96	48.6	5.65	Interpolated
5600	35.5	5.07	48.5	5.77	Interpolated
5700	35.4	5.17	48.3	5.88	Interpolated

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

7.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Parameter Check Result @ Muscle 5200 & 5800 MHz

Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Sunny Shih

Simulating Liquid			Parameters		Target	Measured	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)						
5200	24.5	15	ε"	Relative Permittivity (ϵ_r):	49.0	49.6520	1.33	± 5
			18.7604	Conductivity (σ):	5.30	5.427	2.40	± 5
5800	24.5	15	ε"	Relative Permittivity (ϵ_r):	48.2	48.2866	0.18	± 5
			19.5088	Conductivity (σ):	6.00	6.295	4.91	± 5

Simulating Liquid Dielectric Parameters Check @ 5.2 and 5.8 GHz
Room Ambient Temperature: 25 deg. C, Liquid temperature: 24.0 deg. C
December 14, 2004 11:06 AM

Frequency	e'	e"
4600000000.	50.8382	17.8424
4650000000.	50.7469	17.9161
4700000000.	50.6579	18.0051
4750000000.	50.5635	18.0899
4800000000.	50.4667	18.1778
4850000000.	50.3832	18.2428
4900000000.	50.2739	18.3276
4950000000.	50.2079	18.4214
5000000000.	50.0717	18.4905
5050000000.	49.9750	18.5479
5100000000.	49.8779	18.6190
5150000000.	49.7784	18.7014
5200000000.	49.6520	18.7604
5250000000.	49.5696	18.8373
5300000000.	49.4909	18.8929
5350000000.	49.3692	18.9575
5400000000.	49.2763	19.0152
5450000000.	49.1689	19.0861
5500000000.	49.0779	19.1577
5550000000.	48.9781	19.2093
5600000000.	48.8881	19.2792
5650000000.	48.7810	19.3399
5700000000.	48.7270	19.3956
5750000000.	48.5901	19.4549
5800000000.	48.5339	19.5088
5850000000.	48.4068	19.5521
5900000000.	48.3374	19.6501
5950000000.	48.2320	19.6944
6000000000.	48.1479	19.7934

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where $f = \text{target } f * 10^{6}$

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Parameter Check Result @ Muscle 5200 & 5800 MHz

Ambient Temperature = 24.5°C; Relative humidity = 35% Measured by: Sunny Shih

Simulating Liquid f (MHz)	Temp. (°C)	Depth (cm)	Parameters		Target	Measured	Deviation (%)	Limit (%)
5200	24	15	ε"	Relative Permittivity (ϵ_r):	49.0	49.3149	0.64	± 5
			18.7030	Conductivity (σ):	5.30	5.41045	2.08	± 5
5800	24	15	ε"	Relative Permittivity (ϵ_r):	48.2	48.1878	-0.03	± 5
			19.4660	Conductivity (σ):	6.00	6.28093	4.68	± 5

Simulating Liquid Dielectric Parameters Check @ 5.2 and 5.8 GHz
Room Ambient Temperature: 24.5 deg. C, Liquid temperature: 24.0 deg. C
December 20, 2004 11:18 AM

Frequency	e'	e''
4600000000.	50.5146	17.8186
4650000000.	50.3988	17.8917
4700000000.	50.3569	17.9988
4750000000.	50.1821	18.0613
4800000000.	50.1481	18.1805
4850000000.	50.0155	18.1945
4900000000.	49.9015	18.3048
4950000000.	49.8257	18.3590
5000000000.	49.6835	18.4357
5050000000.	49.6442	18.5221
5100000000.	49.5072	18.5422
5150000000.	49.4484	18.6927
5200000000.	49.3149	18.7030
5250000000.	49.1806	18.8260
5300000000.	49.1336	18.8584
5350000000.	48.9625	18.9184
5400000000.	48.9438	18.9713
5450000000.	48.7989	19.0281
5500000000.	48.7265	19.1078
5550000000.	48.6287	19.1748
5600000000.	48.5171	19.2258
5650000000.	48.4464	19.3234
5700000000.	48.3779	19.3294
5750000000.	48.2496	19.4384
5800000000.	48.1878	19.4660
5850000000.	48.0284	19.5329
5900000000.	47.9939	19.6097
5950000000.	47.8561	19.6184
6000000000.	47.7783	19.7395

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where $f = target\ f * 10^6$

$\varepsilon_0 = 8.854 * 10^{-12}$

8 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3531 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and f 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
- Special 7 x 7 x 8 fine cube was chosen for cube integration(dx=dy=7.5mm; dz=5mm).
- Distance between probe sensors and phantom surface was set to 2.0 (5 G) mm.
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

Reference SAR Values

The reference SAR values were calculated using finite-difference time-domain FDTD method (feed point-impedance set to 50 ohms) and the mechanical dimensions of the D5GHzV2 dipole (manufactured by SPEAG).

f (MHz)	Head Tissue		Body Tissue		
	SAR_{1g}	SAR_{10g}	SAR_{1g}	SAR_{10g}	SAR_{Peak}
5000	72.9	20.7	68.1	19.2	260.3
5100	74.6	21.1	78.8	19.6	272.3
5200	76.5	21.6	71.8	20.1	284.7
5800	78.0	21.9	74.1	20.5	324.7

8.1 SYSTEM PERFORMANCE CHECK RESULTS

@ System Validation Dipole: D5GHzV2 SN 1003 Date: December 14, 2004

Ambient Temperature = 25°C; Relative humidity = 38% Measured by: Sunny Shih

Body Simulating Liquid			Measured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
5200	24.5	15	17.6	70.4	71.8	-1.95	± 10

@ System Validation Dipole: D5GHzV2 SN 1003 Date: December 20, 2004

Ambient Temperature = 24.5°C; Relative humidity = 35% Measured by: Sunny Shih

Body Simulating Liquid			Measured		Target_1g	Deviation[%]	Limit [%]
f (MHz)	Temp. [°C]	Depth [cm]	1g	Normalized to 1 W			
5800	24	15	16.8	67.2	74.1	-9.31	± 10

9 SAR MEASUREMENT PROCEDURES

A summary of the procedure follows:

a) A measurement of the SAR value at a fixed location is used as a reference value for assessing the power drop of the EUT. The SAR at this point is measured at the start of the test, and then again at the end of the test.

b) The SAR distribution at the exposed flat section of the flat phantom is measured at a distance of 2.0 (5 GHz) mm from the inner surface of the shell. The area covers the entire dimension of the EUT and the horizontal grid spacing is 10 mm x 10 mm. Based on this data, the area of the maximum absorption is determined by Spline interpolation. The first Area Scan covers the entire dimension of the EUT to ensure that the hotspot was correctly identified.

c) Around this point, a volume of X=Y=Z=30 mm is assessed by measuring 7 x 7 x 8 (5 GHz) points. On the basis of this data set, the spatial peak SAR value is evaluated with the following procedure:

   (i) The data at the surface are extrapolated, since the centre of the dipoles is 1.2 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm. The extrapolation is based on a least square algorithm. A polynomial of the fourth order is calculated through the points in z-axes. This polynomial is then used to evaluate the points between the surface and the probe tip.

   (ii) The maximum interpolated value is searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g and 10 g) are computed using the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one-dimensional splines with the “Not a knot”- condition (in x, y and z-direction). The volume is integrated with the trapezoidal – algorithm. One thousand points (10 x 10 x 10) are interpolated to calculate the averages.

   (iii) All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

   (iv) The SAR value at the same location as in Step (a) is again measured to evaluate the actual power drift.

DASY4 SAR MEASUREMENT PROCEDURE

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 1. 2 mm for an EX3DV3 probe type).

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures 7 x 7 x 8 (5 GHz) points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

10 PROCEDURES USED TO ESTABLISH TEST SIGNAL

The following procedures had been used to prepare the EUT for the SAR test.

- The client supplied a special driving program to program the EUT to continually transmit the specified maximum power. And also to change the channel frequency.
- Power levels were set to maximum power prior to SAR measurement.

The cable assembly insertion loss of 12.4 dB (including 10 dB pad and 2.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5180	15.6
Middle	5260	16.5
High	5320	17.2

802.11a Turbo Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5210	17.1
Middle	5250	16.9
High	5290	17.1

The cable assembly insertion loss of 12.6 dB (including 10 dB pad and 2.6 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5745	17.0
Middle	5785	17.1
High	5825	17.0

802.11a Turbo Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5760	16.7
High	5805	17

11 SAR MEASUREMENT RESULTS

11.1 HOST # 1 (TOSHIBA, TECRA 8200) – 5.2 GHZ BAND

802.11a - Duty cycle: 100%; Crest factor: 1 Depth of liquid: 15 cm

Sep. dist. [mm]	Mode	Antenna	Ch. #	f [MHz]	*Power reference [V/m]		SAR_1g [mW/g]	
					Before	After	Measured	Limit
12	a	B		5180	8.91	9.00	0.582	1.6
12	a	A		5260	8.52	8.60	0.469	1.6
12	a	B		5260	8.77	8.77	0.598	1.6
12	a	B		5320	9.30	9.20	0.645	1.6
12	a Turbo	B		5200	9.56	9.70	0.737	1.6
12	a Turbo	B		5250	10.10	10.20	0.721	1.6
12	a Turbo	B		5290	10.30	10.10	0.710	1.6

Notes:
1. *: Power reference - The power drift measured at same position in liquid before and after each SAR measurement
2. SAR is tested for a lap-held position with the bottom of the computer in direct contact against a flat phantom.
3. If the SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

11.2 HOST # 1 (TOSHIBA, TECRA 8200) – 5.8 GHZ BAND

802.11a - Duty cycle: 100%; Crest factor: 1 Depth of liquid: 15 cm

Sep. dist. [mm]	Mode	Antenna	Ch. #	f [MHz]	*Power reference [V/m]		SAR_1g [mW/g]	
					Before	After	Measured	Limit
12	a	B		5745	6.01	6.10	0.528	1.6
12	a	A		5745	5.78	5.70	0.480	1.6
12	a	B		5785	6.61	6.61	0.311	1.6
12	a	A		5825	7.81	7.70	0.371	1.6
12	a Turbo	B		5760	7.20	7.10	0.424	1.6
12	a Turbo	B		5805	7.70	7.65	0.391	1.6

Notes:

1. *: Power reference - The power drift measured at same position in liquid before and after each SAR measurement
2. SAR is tested for a lap-held position with the bottom of the computer in direct contact against a flat phantom.
3. If the SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

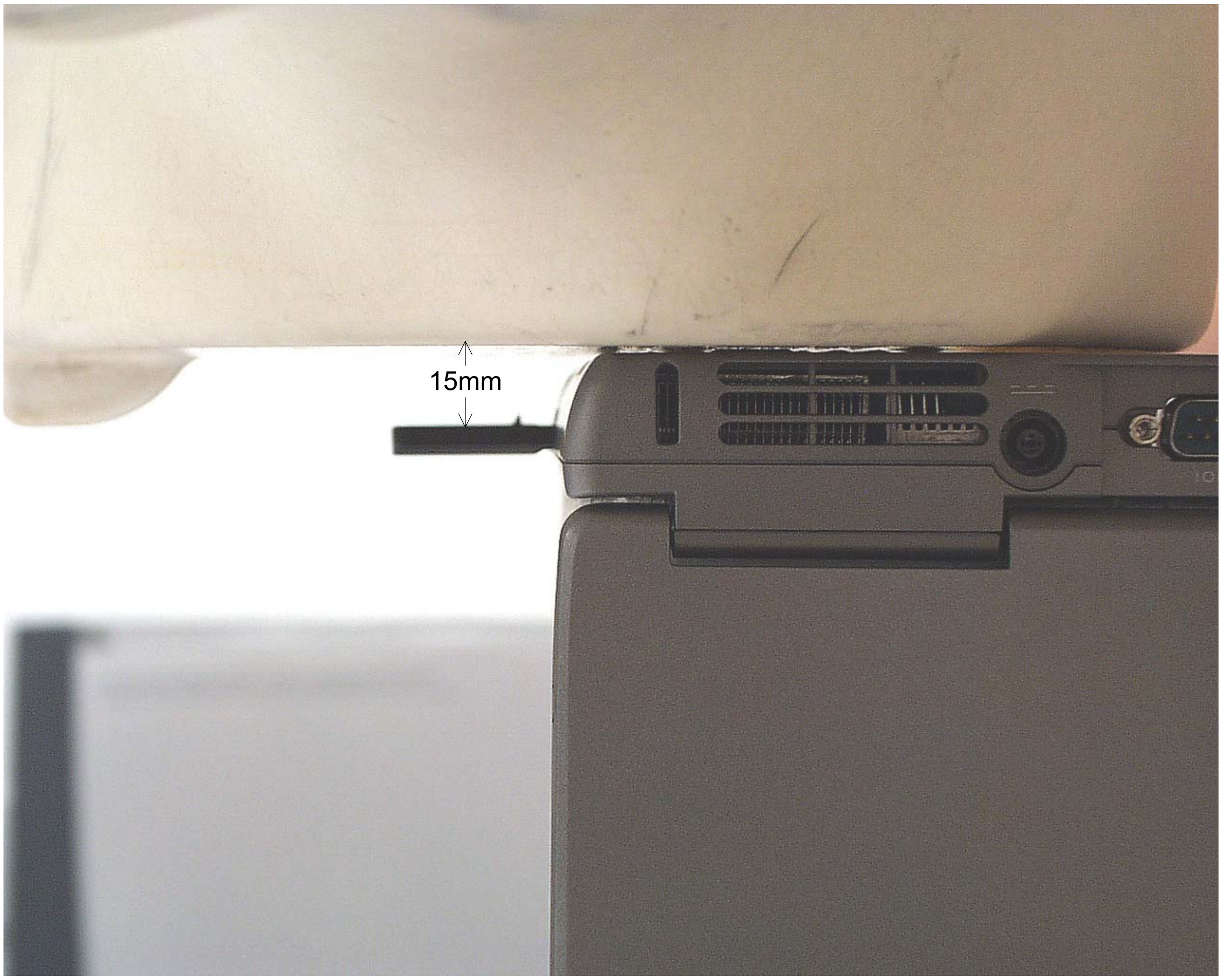
11.3 HOST # 2 (IBM, 2896)

802.11a - Duty cycle: 100%; Crest factor: 1 Depth of liquid: 15 cm

Sep. dist. [mm]	Mode	Antenna	Ch. #	f [MHz]	*Power reference [V/m]		SAR_1g [mW/g]	
					Before	After	Measured	Limit
14	a	B		5320	6.87	6.70	0.366	1.6
14	a Turbo	B		5200	8.08	8.20	0.432	1.6
14	a	B		5745	6.56	6.40	0.394	1.6
14	a Turbo	B		5760	5.89	5.80	0.340	1.6

Notes:
1. *: Power reference - The power drift measured at same position in liquid before and after each SAR measurement
2. SAR is tested for a lap-held position with the bottom of the computer in direct contact against a flat phantom.
3. If the SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

11.4 HOST # 3 (DELL, PP05L)



802.11a - Duty cycle: 100%; Crest factor: 1 Depth of liquid: 15 cm

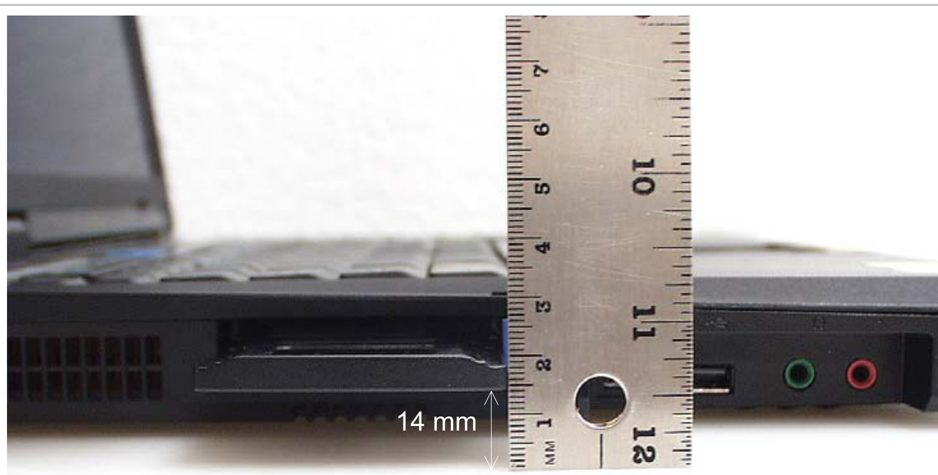
Sep. dist. [mm]	Mode	Antenna	Ch. #	f [MHz]	*Power reference [V/m]		SAR_1g [mW/g]	
					Before	After	Measured	Limit
15	a	B		5260	7.25	7.30	0.288	1.6
15	a	B		5260	6.92	9.95	0.309	1.6
15	a Turbo	B		5200	7.10	7.20	0.286	1.6
15	a	B		5745	7.14	7.10	0.455	1.6
15	a Turbo	B		5760	5.88	5.80	0.411	1.6

Notes:

1. *: Power reference - The power drift measured at same position in liquid before and after each SAR measurement
2. SAR is tested for a lap-held position with the bottom of the computer in direct contact against a flat phantom.
3. If the SAR measured at the middle channel for this configuration is at least 3 dB lower than SAR limit, testing at low & high channel is optional.
4. Please see attachment for the detailed measurement data and plots showing the maximum SAR location of the EUT.

HOST # 1 (TOSHIBA, TECRA 8200)

HOST # 2 (IBM, 2896)



HOST # 3 (DELL, PP05L)

13 MEASUREMENT UNCERTAINTY

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty	RSS					11.44	10.49
Expanded Uncertainty (95% Confidence Interval)	K=2					22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

14 EQUIPMENT LIST & CALIBRATION

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A
S-Parameter Network Analyzer	Agilent	8753ES-6	US39173569	8/19/05
Electronic Probe kit	Hewlett Packard	85070C	N/A	N/A
E-Field Probe	SPEAG	EX3DV3	3531	7/18/05
Thermometer	ERTCO	639-1	8402	10/13/2005
Thermometer	ERTCO	639-1	8404	10/21/2005
Thermometer	ERTCO	637-1	8661	10/21/2005
SAM Phantom (SAM1)	SPEAG	TP-1185	QD000P40CA	N/A
SAM Phantom (SAM2)	SPEAG	TP-1015	N/A	N/A
Data Acquisition Electronics	SPEAG	DAE3 V1	500	12/23/04
System Validation Dipole	SPEAG	D5GHzV2	1003	10/5/05
Signal General	R&H	SMP 04	DE34210	5/5/05
Power Meter	Giga-tronics	8651A	8651404	9/16/05
Power Sensor	Giga-tronics	80701A	1834588	9/16/05
Amplifier	Mini-Circuits	ZVE-8G	0360	N/A
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A
Simulating Liquid	SPEAG	M5200-5800	N/A	Within 24 hrs of first test

15 ATTACHMENTS

No.	Contents	No. of page (s)
1	System Performance Check Plots	6
2-1	SAR Test Plots (5.2 GHz Band)	14
2-3	SAR Test Plots (5.8 GHz Band)	10
3	Certificate of E-filed Probe EX3DV3 SN 3521	8
4	Certificate of System Validation Dipole D5GHzV2 SN 1003	11
5	Material Specification Data Sheet of Body Simulating Liquid (5GHz)	3

END OF REPORT